Semi-plenary #1

INDUSTRY 4.0 AND ERGONOMICS

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The so-called "Industry 4.0" is grounded on some core tenets: information safety, internet of things, cloud computing, integrated systems, additive manufacturing, learning simulations, collaborative robots, augmented reality and big data. Nevertheless, none of them has as much impact on the world of work as artificial intelligence (AI).

The history of AI began in 1950, when Alan Turing (considered the "father" of the modern computer) wrote "if you're using a computer but you fail to see any difference between its answers and those you would expect from a human being, then you might consider that the computer is 'thinking'." The term "artificial intelligence" was minted by John McCarthy in 1956; later advances were gradual and slow, milestones including: 1997 — computer Deep Blue beat the world chess champion Gary Kasparov; 2012 — development of facial recognition, which got AI to another level; 2015 — program AlphaGo beat a European Go champion (to notice, Go is much more complex than chess). Three technologies developed in the past five years — deep learning, machine learning and reinforcement learning — accelerated the pace of advancement. These technologies showed that without being explicitly programmed, computers can learn patterns in data. Giants such as IBM radically changed their business vision and now provide AI technologies to companies.

According to Prof. Waldemar Karwowski, these are some of the basic notions of AI:

- Intelligence: ability to accomplish complex goals
- Artificial intelligence: non-biological intelligence
- Superintelligence: general intelligence far beyond the human level
- Consciousness: subjective experience
- Friendly artificial intelligence: AI which goals are aligned with ours

Here applies the reasoning described by Yuval Harari in his book *Homo Deus* (2015): 1) Organisms are algorithms — each and every animal, including *Homo sapiens*, is an ensemble of organic algorithms shaped by natural selection; 2) Calculations and algorithms are not influenced by the materials used to build the calculator; 3) There is no reason to believe that organic algorithms are able to do things non-organic algorithms cannot or even surpass

One should not think of AI as of robots which can replace humans in mechanical actions or as automated production systems — all of this is available since the Third Industrial Revolution, in the 1970s. While intelligent systems are run in computers, they use big data and by means of the three aforementioned technologies, they learn, analyze, control and interfere with processes at very high speed, pointing to and determining the best possible option for each individual situation.

AI enables dramatic leaps in manufacturing productivity, supply chains, engineering, construction, the aerospace, electronics, metallurgy and mining industries. Many AI processes have already been implemented in the chemical industry, increasing productivity and reducing losses. Similarly, AI-controlled processes play an outstanding role in air traffic control worldwide. In medicine, diagnostic imaging largely depends on systems built into equipment, to the point that the main North American medical scientific journal called experts in this field to revise their approaches.

Karkowski emphasized some of the new aspects of the new technology game. The MIT Technological Review analyzed, in 2017, ten breakthrough technologies able to solve major problems and to pave the road for new opportunities, including self-driving trucks, facial recognition payment and reinforcement learning — by experimenting, computers figure out how to do things with no needed of programming.

Shortly, the game has changed and all of us should be aware: AI systems will be used wherever possible. There are no doubts that such systems are not only able to overcome several imperfections of human systems, but that they also ensure higher competitive productivity. Therefore here applies the rule that has always guided business, to wit, that of isomorphism: whoever is left behind seeks updating to achieve the same level as their competitors.

The main ergonomic aspects for which we need to be ready can be divided into three categories: impacts for company employees, for employees of technology 4.0 firms and for managers.

At the operational level, AI will reduce the number of jobs in companies, at the same time the latter's permanent contracts with technology firms will increase. Skills will be considered volatile and perishable, and workers will be required to advance at the same velocity as their employers to be able to keep their jobs. Therefore, they will need to invest considerable effort in updating their competences, which brings in the notion of resilience, i.e. the ability to overcome frustration and find adequate solutions when facing a chaotic environment. We, health and safety professionals, need to give them support. Yet, there is one positive aspect: although extremely competent and able to make decisions in complex situations, no matter how good AI systems might be, human beings will still play a relevant role when complex decisions are needed and deep awareness of processes is required.

It is expected that AI technical personnel will be subjected to the triad of factors underlying mental disorders: work will be intense, dense and tense, since two of the grounds of technology 4.0 are information safety and system connectivity (which can never fail). The result will be irregular working hours, telework and availability to solve emergencies involving any of these aspects.

The training profile of managers will change: they will require enormous conceptual ability to deal with countless variables, thorough technical ability to understand and manage contracts with technology 4.0 companies, decision making skills in situations requiring awareness, ability to argue with service providers who believe that computerized systems are better than humans in all respects, and critical awareness to ban the exaggerations derived from AI technologies.